

JCO7 Rec'd PCT/PTO 30 MAR 2001

FORM PTO-1390 US DEPARTMENT OF COMMERCE REV. 5-93PATENT AND TRADEMARK OFFICE TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		ATTORNEYS DOCKET NUMBER P01,0104
		U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 09/806542
INTERNATIONAL APPLICATION NO. PCT/EP99/06842	INTERNATIONAL FILING DATE 16 SEPTEMBER 1999	PRIORITY DATE CLAIMED 30 SEPTEMBER 1998
TITLE OF INVENTION METHOD FOR DETERMINING THE POSITION OF TEXT LINES IN TEXT RECOGNITION TASKS		
APPLICANT(S) FOR DO/EO/US WALTER AIGNER ET AL.		
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<ol style="list-style-type: none">1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.2. <input checked="" type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay.4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.5. <input checked="" type="checkbox"/> A copy of International Application as filed (35 U.S.C. 371(c)(2)) .<ol style="list-style-type: none">a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).b. <input type="checkbox"/> has been transmitted by the International Bureau.c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)6. <input checked="" type="checkbox"/> A translation of the International Application into English (35 U.S.C. 371(c)(2)).7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. §371(c)(3))<ol style="list-style-type: none">a. <input type="checkbox"/> are transmitted herewith (required only if not transmitted by the International Bureau).b. <input type="checkbox"/> have been transmitted by the International Bureau.c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.d. <input checked="" type="checkbox"/> have not been made and will not be made.8. <input type="checkbox"/> A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).9. <input type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).10. <input checked="" type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).		
Items 11. to 16. below concern other document(s) or information included:		
<ol style="list-style-type: none">11. <input type="checkbox"/> An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98; (PTO 1449, Prior Art, Search Report, 03 References).12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. 3.28 and 3.31 is included. (SEE ATTACHED ENVELOPE)13. <input checked="" type="checkbox"/> Amendment "A" Prior to Action and Appendix "A". <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment.14. <input checked="" type="checkbox"/> A substitute specification and substitute specification mark-up.15. <input type="checkbox"/> A change of address letter attached to the Declaration.16. <input checked="" type="checkbox"/> Other items or information:<ol style="list-style-type: none">a. <input checked="" type="checkbox"/> Submission of Drawingsb. <input checked="" type="checkbox"/> EXPRESS MAIL #EL 843728521 US dated March 30, 2001		

U.S. APPLICATION NO. (if known, see 37 C.F.R. 1.51)

09/806542

INTERNATIONAL APPLICATION NO.
PCT/EP99/06842ATTORNEY'S DOCKET NUMBER
P01,010417. ☒ The following fees are submitted:**BASIC NATIONAL FEE (37 C.F.R. 1.492(a)(1)-(5):**

Search Report has been prepared by the EPO or JPO \$860.00

International preliminary examination fee paid to USPTO (37 C.F.R. 1.482) \$690.00

No international preliminary examination fee paid to USPTO (37 C.F.R. 1.482) but international search fee paid to USPTO (37 C.F.R. 1.445(a)(2)) \$710.00

Neither international preliminary examination fee (37 C.F.R. 1.482) nor international search fee (37 C.F.R. 1.445(a)(2)) paid to USPTO \$1000.00

International preliminary examination fee paid to USPTO (37 C.F.R. 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) \$ 100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =

CALCULATIONS

PTO USE ONLY

\$ 860.00

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 C.F.R. 1.492(e)).

\$

Claims

Number Filed

Number
Extra

Rate

Total Claims

03 - 20 =

0

X \$ 18.00

\$

Independent Claims

01 - 3 =

0

X \$ 80.00

\$

Multiple Dependent Claims

\$270.00 +

\$

TOTAL OF ABOVE CALCULATIONS =

\$ 860.00

Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 C.F.R. 1.9, 1.27, 1.28)

\$

SUBTOTAL =

\$ 860.00

Processing fee of \$130.00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +

\$

TOTAL NATIONAL FEE =

\$ 860.00

Fee for recording the enclosed assignment (37 C.F.R. 1.21(h). The assignment must be accompanied by an appropriate cover sheet (37 C.F.R. 3.28, 3.31). \$40.00 per property +

TOTAL FEES ENCLOSED =

\$ 860.00

Amount to be
refunded

\$

charged

\$

a. ☒ A check in the amount of \$ 860.00 to cover the above fees is enclosed.b. ☐ Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed.c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 50-1519. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 C.F.R. 1.494 or 1.495 has not been met, a petition to revive (37 C.F.R. 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:SCHIFF HARDIN & WAITE
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6600 Sears Tower
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SIGNATURE

Melvin A. Robinson
NAME

31,870

Registration Number

CUSTOMER NUMBER 26574

BOX PCT
IN THE UNITED STATES DESIGNATED/ELECTED OFFICE
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE
UNDER THE PATENT COOPERATION TREATY--CHAPTER II

5

PRELIMINARY AMENDMENT A
PRIOR TO ACTION

APPLICANT(S): WALTER AIGNER ET AL
ATTORNEY DOCKET NO.: P01,0104
INTERNATIONAL APPLICATION NO: PCT/EP99/06842
INTERNATIONAL FILING DATE: 16 SEPTEMBER 1999
INVENTION: METHOD FOR DETERMINING THE POSITION OF
TEXT LINES IN TEXT RECOGNITION TASKS

Assistant Commissioner for Patents,
Washington D.C. 20231

Sir:

Applicants herewith amend the above-referenced PCT application, and request entry of the Amendment prior to examination on the United States Examination Phase.

IN THE CLAIMS:

On amended page 9:

replace line 1 with --WHAT IS CLAIMED IS:--;

Please replace original claims 1-3 with the following replacement claims 1-3, referring to the mark-ups in Appendix A.

1) (Amended) A method for determining the position of text lines in text recognition tasks, comprising the steps of:

determining a brightness distribution of an acquired image excerpt along a vertical by histogram formation along said lines;

smoothing said brightness distribution is smoothed;

determining a maximum value and a minimum value of a function obtained in this way; and

calculating thresholds that serve as a basis for distinguishing between text line and text interspace calculated based on these extremes;

5 ascertaining a line interspace when said function has a combination of a maximum with a minimum in which said minimum has a value of less than

function minimum + number of pixels over the width of the image excerpt/15 + 2*number of pixels over the width of the image excerpt/15 * function maximum/number of pixels over the width of the image excerpt, and

10 a decrease in the function values after the maximum has a value of greater than (function maximum – function minimum)/2.

2) (Amended) The method according to claim 1, further comprising the step of:

15 determining, in order to ascertain a left-hand edge of a line, said brightness distribution of a captured image excerpt along a horizontal and a function obtained in this way represents a beginning of a line by an abrupt rise in said function value.

20 3) (Amended) A method according to claim 1, further comprising the step of determining, after a position of a line has initially been ascertained, a further profile of said line by evaluating information concerning text characters recognized.


REMARKS

25 The present Amendment revises the specification and claims to conform to United States patent practice, before examination of the present PCT application in the United States National Examination Phase. Pursuant to 37 CFR 1.125 (b), applicants have concurrently submitted a substitute specification, excluding the

claims, and provided a marked-up copy. All of the changes are editorial and applicant believes no new matter is added thereby. The amendment, addition, and/or cancellation of claims is not intended to be a surrender of any of the subject matter of those claims.

Early examination on the merits is respectfully requested.

Submitted by,

 (Reg. No. 31,870)

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Appendix A
Mark Ups for Claim Amendments

This redlined draft, generated by CompareRite (TM) - The Instant Redliner, shows the differences between -
original document : Q:\DOCUMENTS\YEAR 2001\P010104-AIGNER-POSITION
OF TEXT LINES\ORIGINAL CLAIMS.DOC
and revised document: Q:\DOCUMENTS\YEAR 2001\P010104-AIGNER-POSITION
OF TEXT LINES\AMENDED CLAIMS.DOC

CompareRite found 36 change(s) in the text

Deletions appear as Overstrike text surrounded by []
Additions appear as Bold-Underline text

1) ~~[Method]~~ **(Amended) A method** for determining the position of text lines in text recognition tasks, ~~[whereby the]~~ **comprising the steps of:**

determining a brightness distribution of an acquired image excerpt along ~~[the]~~ **a** vertical ~~[is determined]~~ by histogram formation along ~~[the]~~ **said** lines~~], and this];~~

smoothing said brightness distribution is smoothed~~], whereby];~~

determining a maximum value and **a** minimum value of ~~[the]~~ **a** function obtained in this way ~~[are determined];~~ and

calculating thresholds that serve as ~~[the]~~ **a** basis for distinguishing between text line and text interspace ~~[are]~~ calculated **based** on ~~[the basis of]~~ these extremes~~], characterized in that];~~

ascertaining a line interspace ~~[is ascertained]~~ when ~~[the]~~ **said** function has a combination of a maximum with a minimum in which ~~[the]~~ **said** minimum has a value of less than

function minimum + number of pixels over the width of the image excerpt/15 + 2*number of pixels over the width of the image excerpt/15 * function maximum/number of pixels over the width of the image excerpt, and

[the] a decrease in the function values after the maximum has a value of greater than (function maximum – function minimum)/2.

2) ~~[Method]~~**(Amended) The method** according to ~~[one of the Claims 1,~~
5 ~~characterized in that]~~ **claim 1, further comprising the step of:**

determining, in order to ascertain [the] a left-hand edge of a line, [the] **said** brightness distribution of a captured image excerpt along [the] a horizontal [is determined] and [the] a function obtained in this way represents [the] a beginning of a line by an abrupt rise in [the] **said** function value.

10
3) ~~[Method]~~**(Amended) A method** according to ~~[one of Claims 1 or 2,~~
characterized in that after the] **claim 1, further comprising the step of**
determining, after a position of a line has initially been ascertained, [the] a further
15 profile of [the] said line ~~[is determined]~~ by evaluating [the] information concerning
[the] text characters recognized.

SPECIFICATION

JC08 Rec'd PCT/PTO 30 MAR 2001

TITLE

METHOD FOR DETERMINING THE POSITION OF TEXT LINES IN TEXT
RECOGNITION TASKS

5

BACKGROUND OF THE INVENTION

Background of the Invention

[0001] The invention relates to a method for determining the position of text lines in text recognition tasks in which the brightness distribution of an acquired image excerpt along the vertical is determined by histogram formation along the lines, and this brightness distribution is smoothed. A maximum value and minimum value of the function obtained in this way are determined, and thresholds that serve as the basis for distinguishing between text line and text interspace are calculated on the basis of these extremes.

Field of the Invention

15 [0002] In the case of the automatic recognition of texts, that is to say in the case of the conversion of the graphical information of a document into text characters which can be further processed by means of electronic text processing programs, an essential prerequisite for a successful recognition operation is that the position and the size of the individual characters be determined accurately. This presupposes in turn that the position and the dimensions of the text lines be known.

[0003] In the case of manually guided readers, moreover, the profile of the text lines in the captured image excerpt turns out to be non-linear. In this context, there is a need to determine the profile of a text line.

[0004] A method of the species initially cited is disclosed by EP 0702 329 A2.
25 This publication discloses a method and an apparatus for determining the line course given handwritten documents. According to this publication, the picture elements are summed up line-by-line, smoothed and analysed for the determination of the position of the lines.

SUMMARY OF THE INVENTION

[0005] The invention is based on the object of improving this method.

[0006] This is done according to the invention by a method of the type mentioned in the introduction in which a line interspace is identified when the
5 function comprises a combination of a maximum with a minimum. The minimum comprises a value less than *function minimum + plurality of picture elements over the width of the image excerpt* / 15 + 2 * *plurality of the picture elements over the width of the image excerpt* / 15 * *function maximum / plurality of picture elements over the width of the image excerpt* and the drop off of the function values after the maximum
10 comprises a value greater than *(function maximum - function minimum)/2*. This embodiment has proven itself in practice on the basis of very good results.

[0007] An advantageous refinement of the method is provided in which, in order to ascertain the left-hand edge of a line, the brightness distribution of a captured image excerpt along the horizontal is determined and the function obtained
15 in this way represents the beginning of a line by an abrupt rise in the function value. The beginning of a line can thus be determined in a simple manner with little complexity. Furthermore, for the determination of the position of the text lines, it can be ensured that in this case only images which actually contain text lines are taken into consideration and a user error, such as e.g., positioning the reading pen too far
20 to the left of the beginning of a line, does not influence the determination of the line.

[0008] It is expedient if, after the position of a line has initially been ascertained, the further course of the line is determined by evaluating the information concerning the text characters recognized. Evaluating the results of the character classification enables the line profile to be determined particularly
25 accurately.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The invention is explained in more detail with reference to the following exemplary figures.

[0010] Figure 1 is a diagram of a screen shot showing a text excerpt of the
30 kind that is typically captured by a manually guided reader, and also the histogram determined from it; and

[0011] Figure 2 shows the filtered histogram with the parameters entered for the assessment of the image.

DETAILED DESCRIPTION OF THE INVENTION

[0012] The sequence of the method according to the invention is as follows:

- 5 [0013] A line histogram is determined for the captured image excerpt. In this case, for each line, the values of all the pixels of this line (0 for white and 1 for black) are summed. The result is a function $f(y)$ with

[0014]
$$f(y) = \sum_{i=0}^{Width-1} (BlackPixel) \quad \text{where:}$$

[0015] y denotes the line index of the image; and

- 10 [0016] Width indicates the width (number of columns) of the image excerpt.

[0017] When a text is present, this function has a typical profile as illustrated by way of example in Figure 1. In a further step, filtering is carried out in accordance with

[0018]
$$f'(y) = \frac{\sum_{i=-5}^{+5} (f(y+i) * G(i))}{\sum_{i=-5}^{+5} G(i)}$$

- 15 [0019] where:

[0020] y index in the line histogram;

[0021] G weighting corresponding to an exponential smoothing curve; and

[0022] i index of the smoothing curve.

- [0023] During the filtering operation, values are also determined for the
20 absolute maximum *Valuemax* i.e., the number of black pixels of the darkest line and the absolute minimum *Valuemin* i.e., the number of black pixels in the brightest line.

[0024] Parameters for the assessment of the image are derived from these two values. These parameters are:

[0025] $Trough\ limit = (Valuemax - Valuemin)/2$

[0026] but at least *number of pixels over the width of the image excerpt/30*

[0027] $Minima\ edge = Valuemin + \text{number of pixels over the width of the image excerpt}/15$.

5 [0028] but at most $2 * \text{number of pixels over the width of the image excerpt}/15$

[0029] $Minima\ threshold = minimum\ edge + (2 * \text{number of pixels over the width of the image excerpt}/15 * (Valuemax / \text{number of pixels over the width of the image excerpt}))$,

[0030] but at most $3 * \text{number of pixels over the width of the image excerpt}/15$.

10 [0031] Using the function $f(y)$ and the threshold values determined, as are illustrated by way of example in Figure 2, the captured image is then assessed with regard to the presence of text lines and line interspaces.

[0032] For this purpose, the curve profile is examined to see whether values which are smaller than the parameter *minima threshold* are present. If this is the
15 case, then the relevant area is qualified as a valid minimum and thus as a possible line interspace.

[0033] An actual line interspace is present, however, only when the presence of a text line is indicated by an adjoining maximum with a certain characteristic value. These valid maxima are defined by a subsequent decreasing of the curve
20 value by a magnitude $> Trough\ limit$.

[0034] The coincidence of a valid maximum with a valid minimum characterizes the transition from a text line to a line interspace. The parameter *Minima edge* serves for accurately determining this transition.

[0035] The point at which the curve intersects this threshold between a valid
25 maximum and a valid minimum is defined as a line edge.

[0036] In order to determine the left-hand edge of a line, a column histogram is created in accordance with

[0037]
$$f(x) = \sum_{i=0}^{Height-1} (BlackPixel)$$

[0038] where

[0039] x column index of the image excerpt; and

[0040] Height image height

[0041] in words the colour information of the pixels of each column of the
5 captured image excerpt is summed. The left-hand text edge is defined (given the presence of at least one line) by an abrupt rise in the function value $f(x)$.

[0042] The follow-up plotting of the lines (i.e., the information concerning the further profile of the lines, which is important particularly in the case of manually guided readers on account of the fluctuations that occur with the latter) is effected on
10 the basis of the position of the recognized characters.

[0043] For this purpose, the recognized characters are classified into the following size groups:

[0044] Small characters (for example "a") 0.7*line height;

[0045] Large characters (for example "A", "g") line height;

15 [0046] Oversize characters (for example "[", "]") line height + 0.3*line height (descenders);

[0047] Special characters: the characters cannot be unambiguously assigned by size.

[0048] The following character groups are differentiated for the determination
20 of the new lower edge of the text line:

[0049] Baseline characters (for example "A", "."): the lower edge of the character corresponds to the lower edge of the text line, irrespective of the size of the character;

[0050] Descender characters (for example "g", "["): the lower edge of the
25 character corresponds to the descender boundary, irrespective of the size of the character;

[0051] Special characters: these characters cannot be unambiguously assigned with regard to their lower edge.

[0052] On the basis of these assignments and a probability value G relating to the correct classification of the character, this probability value being obtained in the course of the classification method, the new line height *Height* is then determined as follows:

5 [0053] $G = Probability * CYC_MAX_WEIGHT$

[0054]
$$Height = \frac{\sum_{i=0}^{CYC_MAX_EXTRPAR-1} OldHeight[i] + NewHeight * G}{CYC_MAX_EXTRPAR + G}$$

[0055] G weighing of the line height derived from the current character;

10 [0056] $Probability$ probability of correct character classification (range of values between 0 and 1);

[0057] CYC_MAX_WEIGHT maximum weighing of the new character position (for example: 5);

[0058] $Height$ subsequently plotted line height (upper case letter height);

15 [0059] $CYC_MAX_EXTRPAR$ size of the ring buffer for the averaging (for example: 3);

[0060] $OldHeight[]$ ring buffer;

[0061] $NewHeight$ line height derived from the current character (upper case letter height); and

[0062] i index in the ring buffer.

20 [0063] The profile of the lower edge of the text line is determined in accordance with:

[0064]
$$G = \left(Probability + \frac{1}{CYC_MAX_WEIGHT} \right) * CYC_MAX_WEIGHT$$

[0065]
$$Increase = \frac{OldIncrease + NewIncrease * G}{1 + G}$$

[0066]
$$Base = NewBase + \frac{Increase * DeltaX + 50}{100}$$

25 [0067] G weighing of the new character position;

- [0068] Probability probability of correct character classification;
- [0069] CYC_MAX_WEIGHT maximum weighting of the new character position (for example: 5);
- 5 [0070] Increase subsequently plotted current gradient of the baseline in %;
- [0071] OldIncrease previous gradient of the baseline in %;
- [0072] NewIncrease gradient of the base line in % calculated from the position of the current character;
- 10 [0073] Base subsequently plotted baseline position (rounded to an integer value);
- [0074] NewBase baseline position calculated from the position of the current character; and
- [0075] DeltaX X-separation in the image between the two centre points of the characters extracted last.
- 15 [0076] The "Increase" is limited by the plausibility limit CYC_MAX_LINEOFFSET (in the Pocket Reader: 15%).
- [0077] The above-described method is illustrative of the principles of the present invention. Numerous modifications and adaptations will be readily apparent to those skilled in this art without departing from the spirit and scope of the present
- 20 invention.

ABSTRACT

[0078] A method for determining the position of text lines in text recognition tasks as specified in which the brightness distribution of a captured image excerpt along the vertical is determined and this brightness distribution is filtered. In the
5 method, maxima and minima of the function obtained in this way are determined and, on the basis of these extrema, threshold values are calculated which serve as a basis for distinguishing between text line and line interspace. The method can be used particularly advantageously in the case of manually guided electronic readers.

This redlined draft, generated by CompareRite (TM) - The Instant Redliner, shows the differences between -

original document : Q:\DOCUMENTS\YEAR 2001\P010104-AIGNER-POSITION OF TEXT LINES\ORIGINAL SPECIFICATION.DOC

- 5 and revised document: Q:\DOCUMENTS\YEAR 2001\P010104-AIGNER-POSITION OF TEXT LINES\SUBSTITUTE SPECIFICATION.DOC

CompareRite found 91 change(s) in the text

- 10 Deletions appear as Overstrike text surrounded by []
Additions appear as Bold-Underline text

[Method for determining the position of text lines in text recognition tasks

SPECIFICATION

15 **TITLE**

METHOD FOR DETERMINING THE POSITION OF TEXT LINES IN TEXT RECOGNITION TASKS

BACKGROUND OF THE INVENTION

Background of the Invention

- 20 **[0001]** The invention relates to a method for determining the position of text lines in text recognition tasks~~[, whereby]~~ **in which** the brightness distribution of an acquired image excerpt along the vertical is determined by histogram formation along the lines, and this brightness distribution is smoothed~~[, whereby]~~. **A** maximum value and minimum value of the function obtained in this way are determined, and thresholds that serve as the basis for distinguishing between text line and text interspace are calculated on the basis of these extremes.

25 **Field of the Invention**

- [0002]** In the case of the automatic recognition of texts, that is to say in the case of the conversion of the graphical information of a document into text characters which can be further processed by means of electronic text processing programs, an essential prerequisite for a successful recognition operation is that the position and the size of the individual characters be determined
30 accurately. This presupposes in turn that the position and the dimensions of the text lines be known.

[0003] In the case of manually guided readers, moreover, the profile of the text lines in the captured image excerpt turns out to be non-linear. In this context, there is a need to determine the profile of a text line.

[0004] A method of the species initially cited is disclosed by EP 0702 329 A2. This publication discloses a method and an apparatus for determining the line course given handwritten documents. According to this publication, the picture elements are summed up line-by-line, smoothed and analysed for the determination of the position of the lines.

5

SUMMARY OF THE INVENTION

[0005] The invention is based on the object of improving this method.

[0006] This is done according to the invention by ~~[means of]~~ a method of the type mentioned in the introduction ~~[wherein]~~ **in which** a line interspace is identified when the function comprises a combination of a maximum with a minimum~~[, whereby the]~~. **The** minimum comprises a value less
10 than *function minimum + plurality of picture elements over the width of the image excerpt / 15 + 2 * plurality of the picture elements over the width of the image excerpt / 15 * function maximum / plurality of picture elements over the width of the image excerpt* and the drop off of the function values after the maximum comprises a value greater than *(function maximum - function minimum) / 2*. This embodiment has proven itself in practice on the basis of very good results.

15 ~~[Advantage is afforded by a]~~ **[0007]** **An advantageous** refinement of the method ~~[wherein]~~ **is provided in which,** in order to ascertain the left-hand edge of a line, the brightness distribution of a captured image excerpt along the horizontal is determined and the function obtained in this way represents the beginning of a line by an abrupt rise in the function value. The beginning of a line can thus be determined in a simple manner with little complexity. Furthermore, for the determination of the
20 position of the text lines, it can be ensured that in this case only images which actually contain text lines are taken into consideration and a user error, such as e.g., positioning the reading pen too far to the left of the beginning of a line, does not influence the determination of the line.

[0008] It is expedient if, after the position of a line has initially been ascertained, the further course of the ~~[said]~~ line is determined by evaluating the information concerning the text characters
25 recognized. Evaluating the results of the character classification enables the line profile to be determined particularly accurately.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The invention is explained in more detail with reference to ~~[figures, in which, by way of example;~~
30 **the following exemplary figures.**

[0010] Figure 1 ~~[shows]~~ **is a diagram of a screen shot showing** a text excerpt of the kind that is typically captured by a manually guided reader, and also the histogram determined ~~[therefrom]~~ **from it;** and

[0011] Figure 2 shows the filtered histogram with the parameters entered for the assessment
35 of the image.

DETAILED DESCRIPTION OF THE INVENTION

[0012] The sequence of the method according to the invention is as follows:

[0013] A line histogram is determined for the captured image excerpt. In this case, for each line, the values of all the pixels of this line (0 for white and 1 for black) are summed. The result is a function $f(y)$ with

[0014]
$$f(x) = \sum_{i=0}^{Width} (BlackPixel)$$
 where:

[0015] y denotes the line index of the image; and

[0016] $Width$ indicates the width (number of columns) of the image excerpt.

[0017] When a text is present, this function has a typical profile as illustrated by way of example in Figure 1. In a further step, filtering is carried out in accordance with

[0018]
$$f'(x) = \frac{\sum_{i=-5}^{+5} (f(x+i) * G(i))}{\sum_{i=-5}^{+5} G(i)}$$

[0019] where:

[0020] y index in the line histogram;

[0021] G weighting corresponding to an exponential smoothing curve; and

[0022] i index of the smoothing curve.

[0023] During the filtering operation, values are also determined for the absolute maximum $Valuemax$ i.e., the number of black pixels of the darkest line and the absolute minimum $Valuemin$ i.e., the number of black pixels in the brightest line ~~are also determined.~~

1.

[0024] Parameters for the assessment of the image are derived from these two values. ~~The said~~ These parameters are:

[0025] $Trough\ limit = (Valuemax - Valuemin)/2$

[0026] but at least *number of pixels over the width of the image excerpt/30*

[0027] $Minima\ edge = Valuemin + \text{number of pixels over the width of the image excerpt}/15$

[0028] but at most $2 * \text{number of pixels over the width of the image excerpt}/15$

[0029] $Minima\ threshold = minimum\ edge + (2 * \text{number of pixels over the width of the image excerpt}/15 * (Valuemax / \text{number of pixels over the width of the image excerpt}))$

[0030] but at most 3*number of pixels over the width of the image excerpt/15.

[0031] Using the function $f(y)$ and the threshold values determined, as are illustrated by way of example in Figure 2, the captured image is then assessed with regard to the presence of text lines and line interspaces.

- 5 **[0032]** For this purpose, the curve profile is examined to see whether values which are smaller than the parameter *minima threshold* are present. If this is the case, then the relevant area is qualified as a valid minimum and thus as a possible line interspace.

- [0033]** An actual line interspace is present, however, only when the presence of a text line is indicated by an adjoining maximum with a certain characteristic value. These valid maxima are
10 defined by a subsequent decreasing of the curve value by a magnitude > *Trough limit*.

[0034] The coincidence of a valid maximum with a valid minimum characterizes the transition from a text line to a line interspace. The parameter *Minima edge* serves for accurately determining this transition.

- [0035]** The point at which the curve intersects this threshold between a valid maximum and a
15 valid minimum is defined as a line edge.

[0036] In order to determine the left-hand edge of a line, a column histogram is created in accordance with

[0037]
$$f(x) = \sum_{i=0}^{\text{Height}} (\text{BlackPixel})$$

[0038] where

- 20 **[0039]** x column $\{x \dots \text{column}\}$ index of the image excerpt; and

[0040] Height $\{ \dots \text{image} \}$ image height

[0041] in words the colour information of the pixels of each column of the captured image excerpt is summed. The left-hand text edge is defined (given the presence of at least one line) by an abrupt rise in the function value $f(x)$.

- 25 **[0042]** The follow-up plotting of the lines, that is to say (i.e., the information concerning the further profile of the lines, which is important particularly in the case of manually guided readers on account of the fluctuations that occur with the latter, is effected on the basis of the position of the recognized characters.

- [0043]** For this purpose, the recognized characters are classified into the following size
30 groups:

[0044] Small characters (for example "a") 0.7*line height;

[0045] Large characters (for example "A","g") line height;

[0046] Oversize characters (for example "[",";") line height +0.3*line height
(descenders);

- [0047]** Special characters: the characters cannot be unambiguously assigned by size.
- [0048]** The following character groups are differentiated for the determination of the new lower edge of the text line:
- [0049]** Baseline characters (for example "A", "."): the lower edge of the character corresponds to the lower edge of the text line, irrespective of the size of the character;
- [0050]** Descender characters (for example "g", "["): the lower edge of the character corresponds to the descender boundary, irrespective of the size of the character;
- [0051]** Special characters: these characters cannot be unambiguously assigned with regard to their lower edge.
- 10 **[0052]** On the basis of these assignments and a probability value G relating to the correct classification of the character, ~~the said~~ **this** probability value being obtained in the course of the classification method, the new line height $Height$ is then determined as follows:
- [0053]** $G = Wahrscheinlichkeit * CYC_MAX_WEIGHT$
- [0054]**
$$Height = \frac{\sum_{i=0}^{CYC_MAX_EXTRPAR} OldHeight[i] + NewHeight * G}{CYC_MAX_EXTRPAR + G}$$
- 15 **[0055]** G weighing of the line height derived from the current character;
[0056] Probability probability of correct character classification (range of values between 0 and 1);
[0057] CYC_MAX_WEIGHT maximum weighing of the new character position (for example: 5);
- 20 **[0058]** $Height$ subsequently plotted line height (upper case letter height);
[0059] $CYC_MAX_EXTRPAR$ size of the ring buffer for the averaging (for example: 3);
[0060] $OldHeight[i]$ ring buffer;
[0061] $NewHeight$ line height derived from the current character (upper case letter height); and
- 25 **[0062]** i index in the ring buffer;
[0063] The profile of the lower edge of the text line is determined in accordance with:
[0064]

$$G = \left(Wahrscheinlichkeit + \frac{1}{CYC_MAX_WEIGHT} \right) * CYC_MAX_WEIGHT$$

30 **[0065]**
$$Increase = \frac{OldIncrease + NewIncrease * G}{1 + G}$$

[0066]
$$Base = NewBase + \frac{Increase * DeltaX + 50}{100}$$

[0067] G weighing of the new character position_i

[0068] Probability probability of correct character classification_i

[0069] CYC_MAX_WEIGHT maximum weighting of the new character position (for example: 5)_i

[0070] Increase subsequently plotted current gradient of the baseline in %_i

[0071] OldIncrease previous gradient of the baseline in %_i

[0072] NewIncrease gradient of the base line in % calculated from the position of the current character_i

10 [0073] Base subsequently plotted baseline position (rounded to an integer value)_i

[0074] NewBase baseline position calculated from the position of the current character_i
and

[0075] DeltaX X-separation in the image between the two centre points of the characters extracted last.

15 [0076] The "Increase" is limited by the plausibility limit CYC_MAX_LINEOFFSET (in the Pocket Reader: 15%).

{Abstract

[0077] The above-described method is illustrative of the principles of the present invention. Numerous modifications and adaptations will be readily apparent to those skilled in this art without departing from the spirit and scope of the present invention.

ABSTRACT

[0078]

A method for determining the position of text lines in text recognition tasks as specified in which the brightness distribution of a captured image excerpt along the vertical is determined and this brightness distribution is filtered[, in which]. In the method, maxima and minima of the function obtained in this way are determined and, on the basis of these extrema, threshold values are calculated which serve as a basis for distinguishing between text line and line interspace. {
5 }The method can be used particularly advantageously in the case of manually guided electronic readers.

JC08 Rec'd PCT/PTO 30 MAR 2001

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Method for determining the position of text lines in text recognition tasks

The invention relates to a method for determining the position of text lines in text recognition tasks, whereby the
5 brightness distribution of an acquired image excerpt along the vertical is determined by histogram formation along the lines, and this brightness distribution is smoothed, whereby maximum value and minimum value of the function obtained in this way are determined, and thresholds that serve as the basis for
10 distinguishing between text line and text interspace are calculated on the basis of these extremes.

In the case of the automatic recognition of texts, that is to say in the case of the conversion of the graphical information of a document into text characters which can be further
15 processed by means of electronic text processing programs, an essential prerequisite for a successful recognition operation is that the position and the size of the individual characters be determined accurately. This presupposes in turn that the position and the dimensions of the text lines be known.

20 In the case of manually guided readers, moreover, the profile of the text lines in the captured image excerpt turns out to be non-linear. In this context, there is a need to determine the profile of a text line.

A method of the species initially cited is disclosed by EP
25 0702 329 A2. This publication discloses a method and an apparatus for determining the line course given handwritten documents. According to this publication, the picture elements are summed up line-by-line, smoothed and analyzed for the determination of the position of the lines.

30 The invention is based on the object of improving this method.

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This is done according to the invention by means of a method of the type mentioned in the introduction wherein a line interspace is identified when the function comprises a combination of a maximum with a minimum, whereby the minimum
5 comprises a value less than $\text{function minimum} + \text{plurality of picture elements over the width of the image excerpt} / 15 + 2 * \text{plurality of the picture elements over the width of the image excerpt} / 15 * \text{function maximum} / \text{plurality of picture elements over the width of the image excerpt}$ and the drop off
10 of the function values after the maximum comprises a value greater than $(\text{function maximum} - \text{function minimum}) / 2$. This embodiment has proven itself in practice on the basis of very good results.

Advantage is afforded by a refinement of the method wherein in
15 order to ascertain the left-hand edge of a line, the brightness distribution of a captured image excerpt along the horizontal is determined and the function obtained in this way represents the beginning of a line by an abrupt rise in the function value. The beginning of a line can thus be determined
20 in a simple manner with little complexity. Furthermore, for the determination of the position of the text lines, it can be ensured that in this case only images which actually contain text lines are taken into consideration and a user error, such as e.g. positioning the reading pen too far to the left of the
25 beginning of a line, does not influence the determination of the line.

It is expedient if after the position of a line has initially been ascertained, the further course of the said line is determined by evaluating the information concerning the text

characters recognized. Evaluating the results of the character classification enables the line profile to be determined particularly accurately.

5 The invention is explained in more detail with reference to figures, in which, by way of example:

Figure 1 shows a text excerpt of the kind that is typically captured by a manually guided reader, and also the histogram determined therefrom and

10 Figure 2 shows the filtered histogram with the parameters entered for the assessment of the image.

The sequence of the method according to the invention is as follows:

15 A line histogram is determined for the captured image excerpt. In this case, for each line, the values of all the pixels of this line (0 for white and 1 for black) are summed. The result is a function $f(y)$ with

$$f(y) = \sum_{i=0}^{Width-1} (BlackPixel) \quad \text{where}$$

20

y denotes the line index of the image

Width indicates the width (number of columns) of the image excerpt

25 When a text is present, this function has a typical profile as illustrated by way of example in Figure 1. In a further step, filtering is carried out in accordance with

$$f'(y) = \frac{\sum_{i=-5}^{+5} (f(y+i) * G(i))}{\sum_{i=-5}^{+5} G(i)}$$

where

30 y index in the line histogram

G weighting corresponding to an exponential smoothing curve
 i index of the smoothing curve

5 During the filtering operation, the absolute maximum *Valuemax* i.e. the number of black pixels of the darkest line and the absolute minimum *Valuemin* i.e. the number of black pixels in the brightest line are also determined.

10 Parameters for the assessment of the image are derived from these two values. The said parameters are:

Trough limit = (Valuemax - Valuemin)/2

15 but at least number of pixels over the width of the image excerpt/30

Minima edge = Valuemin + number of pixels over the width of the image excerpt/15

20 but at most 2*number of pixels over the width of the image excerpt/15

*Minima threshold = minimum edge + (2*number of pixels over the width of the image excerpt/15 * (Valuemax/number of pixels over the width of the image excerpt))*

25 but at most 3*number of pixels over the width of the image excerpt/15

30 Using the function $f'(y)$ and the threshold values determined, as are illustrated by way of example in Figure 2, the captured image is then assessed with regard to the presence of text lines and line interspaces.

35 For this purpose, the curve profile is examined to see whether values which are smaller than the parameter *minima threshold* are present. If this is the case, then the relevant area is qualified as a valid minimum and thus as a possible line interspace.

An actual line interspace is present, however, only when the presence of a text line is indicated by an adjoining maximum with a certain characteristic value. These valid maxima are defined by subsequent decreasing of the curve value by a magnitude $> \textit{Trough limit}$.

The coincidence of a valid maximum with a valid minimum characterizes the transition from a text line to a line interspace. The parameter *Minima edge* serves for accurately determining this transition.

The point at which the curve intersects this threshold between a valid maximum and a valid minimum is defined as a line edge.

In order to determine the left-hand edge of a line, a column histogram is created in accordance with

$$f(x) = \sum_{i=0}^{\textit{Height}-1} (\textit{BlackPixel})$$

x column index of the image excerpt
Heightimage height

in words the colour information of the pixels of each column of the captured image excerpt is summed. The left-hand text edge is defined (given the presence of at least one line) by an abrupt rise in the function value $f(x)$.

The follow-up plotting of the lines, that is to say the information concerning the further profile of the lines, which is important particularly in the case of manually guided readers on account of the fluctuations that occur with the latter, is effected on the basis of the position of the recognized characters.

For this purpose, the recognized characters are classified into the following size groups:

Small characters (for example "a") 0.7*line height
 Large characters (for example "A", "g") line height
 Oversize characters (for example "[", "j") line height
 +0.3*line height (descenders)

- 5 Special characters: the characters cannot be unambiguously assigned by size.

The following character groups are differentiated for the determination of the new lower edge of the text line:

10

Baseline characters (for example "A", "."): the lower edge of the character corresponds to the lower edge of the text line, irrespective of the size of the character;

- 15 Descender characters (for example "g", "["): the lower edge of the character corresponds to the descender boundary, irrespective of the size of the character;

Special characters: these characters cannot be unambiguously assigned with regard to their lower edge.

- 20 On the basis of these assignments and a probability value G relating to the correct classification of the character, the said probability value being obtained in the course of the classification method, the new line height *Height* is then determined as follows:

25

$$G = \text{Probability} * \text{CYC_MAX_WEIGHT}$$

$$\text{Height} = \frac{\sum_{i=0}^{\text{CYC_MAX_EXTRPAR}-1} \text{OldHeight}[i] + \text{NewHeight} * G}{\text{CYC_MAX_EXTRPAR} + G}$$

30

G weighing of the line height derived from the current character

Probability probability of correct character classification (range of values between 0 and 1)

CYC_MAX_WEIGHT maximum weighing of the new
 character position (for example: 5)
 Height subsequently plotted line height
 (upper case letter height)
 5 CYC_MAX_EXTRPAR size of the ring buffer for the
 averaging (for example: 3)
 OldHeight[] ring buffer
 NewHeight line height derived from the current
 character (upper case letter height)
 10 i index in the ring buffer

The profile of the lower edge of the text line is determined in accordance with:

$$15 \quad G = \left(\text{Probability} + \frac{1}{\text{CYC_MAX_WEIGHT}} \right) * \text{CYC_MAX_WEIGHT}$$

$$\text{Increase} = \frac{\text{OldIncrease} + \text{NewIncrease} * G}{1 + G}$$

$$\text{Base} = \text{NewBase} + \frac{\text{Increase} * \text{DeltaX} + 50}{100}$$

20 G weighing of the new character position
 Probability probability of correct character
 classification
 CYC_MAX_WEIGHT maximum weighting of the new character
 25 position (for example: 5)
 Increase subsequently plotted current gradient of
 the baseline in %
 OldIncrease previous gradient of the baseline in %
 NewIncrease gradient of the base line in % calculated
 30 from the position of the current character
 Base subsequently plotted baseline position
 (rounded to an integer value)
 NewBase baseline position calculated from the
 position of the current character

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New Patent Claims

- 1) Method for determining the position of text lines in text recognition tasks, whereby the brightness distribution of an acquired image excerpt along the vertical is determined by
5 histogram formation along the lines, and this brightness distribution is smoothed, whereby maximum value and minimum value of the function obtained in this way are determined, and thresholds that serve as the basis for distinguishing between text line and text interspace are calculated on the basis of
10 these extremes, characterized in that a line interspace is ascertained when the function has a combination of a maximum with a minimum in which the minimum has a value of less than function minimum + number of pixels over the width of the image excerpt/15 + 2*number of pixels over the width of the
15 image excerpt/15 * function maximum/number of pixels over the width of the image excerpt, and the decrease in the function values after the maximum has a value of greater than (function maximum - function minimum)/2.
- 2) Method according to one of the Claims 1, **characterized** in
20 that in order to ascertain the left-hand edge of a line, the brightness distribution of a captured image excerpt along the horizontal is determined and the function obtained in this way represents the beginning of a line by an abrupt rise in the function value.
- 25 3) Method according to one of Claims 1 or 2, **characterized** in that after the position of a line has initially been ascertained, the further profile of the said line is determined by evaluating the information concerning the text characters recognized.

Abstract

A method for determining the position of text lines in text
recognition tasks as specified in which the brightness
5 distribution of a captured image excerpt along the vertical
is determined and this brightness distribution is filtered,
in which maxima and minima of the function obtained in this
way are determined and, on the basis of these extrema,
threshold values are calculated which serve as a basis for
10 distinguishing between text line and line interspace.

The method can be used particularly advantageously in the
case of manually guided electronic readers.

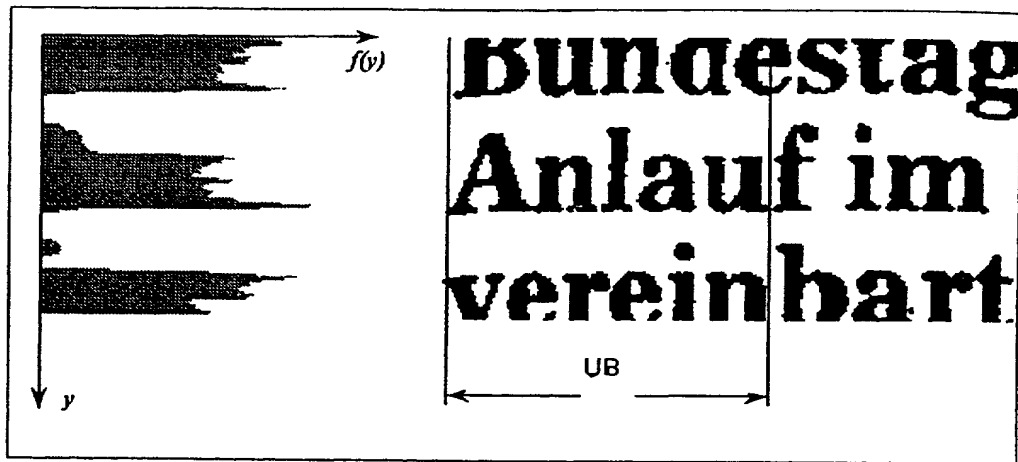


Fig. 1

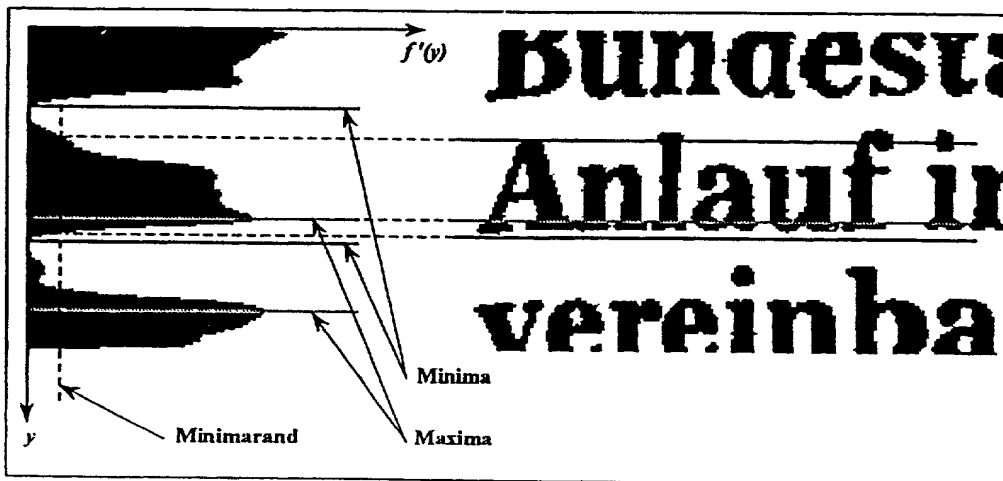


Fig. 2

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION
ERKLÄRUNG FÜR PATENTANMELDUNGEN MIT VOLLMACHT
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für des dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

**Verfahren Zur Bestimmung Der Lage Von Textzeilen
Bei Texterkennungsaufgaben**

deren Beschreibung

(zutreffendes ankreuzen)

☒ hier beigefügt ist.

☐ am _____ als

PCT internationale Anmeldung

PCT Anwendungsnummer _____

eingereicht wurde und am _____

abgeändert wurde.

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56 von Wichtigkeit sind, an.

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

the specification of which

(check one)

☐ is attached hereto

☐ was filed on _____ as

PCT international application

PCT Application No. _____

and was amended on _____

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

German Language Declaration

Prior foreign applications
Priorität beansprucht

A 1623/98 Austria 30 September 1998
(Number) (Country) (Day Month Year Filed)
(Nummer) (Land) (Tag Monat Jahr eingereicht)

(Number) (Country) (Day Month Year Filed)
(Nummer) (Land) (Tag Monat Jahr eingereicht)

(Number) (Country) (Day Month Year Filed)
(Nummer) (Land) (Tag Monat Jahr eingereicht)

Priority Claimed

☒ ☐
Yes No
Ja Nein

☐ ☐
Yes No
Ja Nein

☐ ☐
Yes No
Ja Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56 meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

(Application Serial No.)
(Anmeldeseriennummer)

(Filing Date)
(Anmeldedatum)

(Application Serial No.)
(Anmeldeseriennummer)

(Filing Date)
(Anmeldedatum)

I hereby claim the benefit under Title 35, United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122 I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Status)
(patentiert, anhängig,
aufgegeben)

(Status)
(patented, pending,
abandoned)

(Status)
(patentiert, anhängig,
aufgegeben)

(Status)
(patented, pending,
abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden koennen, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

And I hereby appoint all Attorneys identified by United States Patent & Trademark Office customer number 26574, who are all members of the firm of Schiff Hardin and Waite.

Telefongespräche bitte richten an:
(Name und Telefonnummer)

Direct Telephone Calls to: (name and telephone number)

312/258-5500

Postanschrift:

Send Correspondence to:

SCHIFF HARDIN & WAITE

PATENT DEPARTMENT

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CUSTOMER NUMBER 26574

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Unterschrift des Erfinders <i>Walter Aigner</i> Datum 6.6.2001	Inventor's signature Date
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A-4020 Linz Austria	

Voller Name des zweiten Miterfinders (falls zutreffend): ZAGLER, Bertram	Full name of second joint inventor, if any:
Unterschrift des Erfinders <i>Bertram Zagler</i> Datum 03.07.2001	Inventor's signature Date
Wohnsitz Graz, Austria	Residence
Staatsangehörigkeit Austria AUX	Citizenship
Postanschrift Krottendorferstr. 90/3/28	Post Office Address
A-8052 Graz Austria	

(Bitte entsprechende Informationen und Unterschriften im Falle von weiteren Miterfindern angeben).

(Supply similar information and signature for subsequent joint inventors).